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THE RELATION BETWEEN PHYSIOLOGICAL PSYCHOLOGY AND BEHAVIOR PSYCHOLOGY

IN theoretical discussions about psychological systems, the historical fact that there has always been an alternation in the emphasis, now placed on the physical and now on the mental aspects of human conduct, has been used as an argument to show that behaviorism merely represents the extreme swing of the pendulum when the interest in psychology is directed toward the physiological phase. From this point it is easy to glide into the aphorism "All extremes are bad" and the conclusion that "Therefore the *true* psychology lies somewhere between" can hardly be resisted.

While interest in the physiological aspect of traditional psychology undoubtedly contributed to the origin of behaviorism yet it is primarily the development in the natural sciences that were most effective in creating those differences that now exist in fundamental assumptions, in methodology, and in subject-matter, between physiological psychology and behaviorism, and which it is the purpose of this paper to describe.

DIFFERENCES IN FUNDAMENTAL ASSUMPTIONS

With respect to the fundamental assumptions underlying the mental and social sciences two questions may be asked:

1. Can the subject-matter be reduced to a single series of elements, or is it necessary to postulate a number of orders of elements between which no attributive similarities exist? If only a single series of elements is posited, we have a monistic system; if a number of existentially independent classes of components seem necessary for a complete understanding of the phenomena being investigated, we have a dualistic or a pluralistic system. The relation to a monistic or pluralistic theory of explanation is thus one of the first questions that may be asked about a mental or social science.

2. The second question concerns itself with the type of relationship that exists between those elements (or classes of elements) that represent the ultimate analysis of the subject-matter. This relationship may be either causal or non-causal, depending on whether there is or is not a quantitative identity or invariable sequence in the stages between successive events.

The pluralistic-monistic relation is considered first.

Physiological Psychology is based on Dualism.—Physiological psychology is defined as the science which investigates the correlations that exist between the structure of the human nervous mechanism and the phenomena of consciousness.¹

¹ Ladd and Woodworth, *Elements of Physiological Psychology*, 1915, p. 3.

This definition clearly implies two existentially distinct types of facts, consciousness or mind, on the one hand, and the nervous mechanism, on the other. Consciousness is regarded as made up of those elements that are reported as present by a subject when a particular experimental method is followed. This method is usually characterized as introspection or self-observation and is relied upon for an analysis of mental complexes into elementary sensations, images and feelings. Just what experiences are to be included under these three terms, or whether these three classes are too many or too few has not yet been definitely agreed upon. There is, however, enough uniformity of opinion to warrant the use of the terms without an attempt at rigorous delimitation. Under the nervous mechanism the physiological psychologist includes those bodily structures whose function is that of sensitivity, conductivity and contractility.

As proof of the existence of the mental series the psychologist resorts to demonstration. A subject may be placed in such a position that the stimuli acting on the sense organs, and the actions that result, are reduced to a minimum. Under these conditions if the subject is asked what is going on in his mind he may report a wealth of imagery, feelings of pleasantness or unpleasantness far beyond what could reasonably be expected from a consideration of the magnitudes of the neural activity that either the subject or the experimenter can detect. Furthermore the subject will report that his imagery and feelings would have been practically the same whether he had actually reported them or not. When this experiment is repeated with other subjects the uniformity in the results approaches the limits regarded as adequate for any scientific observation and therefore the conclusion that there are mental processes, in addition to neural processes seems justified. The dualistic character of physiological psychology finds its support in the assumption that the properties of the neural structures or processes are so different from the properties of the mental states or processes that they should be regarded as two different existential orders. A dualism made up of mental phenomena, on the one hand, and neural phenomena, on the other, is thus established.

Behaviorism is based on Monism.—For the behaviorist the mental series is regarded as only another neural series. He does not believe that the conclusion “there are mental states in addition to neural processes” is warranted from the experiment that is supposed to demonstrate the existence of mental states. All the experiment reveals is the fact that the sound waves that form the words of the oral stimulus “What is in your mind?” do not correspond in energy, properties, or duration to the energy, properties, or dura-

tion of the actions (introspections) that may be released. To say that the introspections reveal the existence of mental states is to infer the existence of a category of attributes (conscious elements) so dissimilar from those (sound waves and neural sensorimotor activity) upon which the inference is based, that its validity is doubtful. While in natural science it is quite common to infer the presence of some non-observed physical or chemical properties, yet such an inference does not violate the assumption that there is a mechanical equivalence between the successive stages in the process under investigation. Furthermore the traditional psychologist does not use the inference by claiming a causal relationship between the mental states and the behavior. If in the last analysis the attributes of consciousness can only be derived from the relation between stimulus and response the interpolation of a hypothetical conscious factor seems superfluous to the behaviorist.

Thus the "mere awareness of redness" of an apple for instance, instead of representing a separate conscious factor, represents merely a form of sensorimotor function in which neither the sense organs, the neural paths, nor the motor reaction (assuming that the awareness is not actually expressed as speech) can be localized or discriminated. That is to say "mere awareness" is a limiting condition arising from the fact that there are no sense organs in the nervous system, the adequate stimulus for which is the passage of a nervous excitation, or the changes in neurons that have been produced by previous function. The other limit is represented by the objective statement, "This is an apple," in which it is possible to discriminate the location of the receptors (eye) and the approximate position of the effectors (muscles of the speech mechanism or movements of the hand or arm). From this standpoint the mental and the physical, or the subjective and the objective, instead of being regarded as two separate entities, merely represent the minimum and maximum limits to which sensorimotor activity may itself be reacted to, or discriminated. It is in this sense that behaviorism is monistic.

The second question, the causal interrelationships between the elements may now be considered.

Physiological Psychology not a Causal Series.—The elements of physiological psychology may be studied in three types of relationship: (1) The relationship between the separate mental elements; (2) The relationship between the separate neural elements; (3) The reciprocal relationship between the mental and the neural elements.

1. Psychologists are fairly well agreed that the elements of the mental series do not form a causal relationship or series in the sense that there are any number of intermediate steps between the separate

elements or that the order in which they succeed each other is invariable. It is impossible to observe, for instance, the various stages by which one image is displaced by another, or to regard the succession as in any way maintaining a quantitative identity analogous to those physical energy transformations from which the concept of causality has been developed. The actual investigation of the mental series, as such, is restricted to that of cataloguing the conscious states or processes of those persons that have been specially trained in introspection. Mental states merely occur, and this is all that can be maintained.

2. The sciences of neurology and physiology supply the conceptions underlying the relationship between the neural elements. Both the physiological psychologist and the behaviorist are agreed that these relationships conform to the natural science concept of causation and it will not be necessary to discuss them further.

3. The third form of relationship that the physiological psychologist investigates is that existing between conscious processes and nervous function. The interest in the physiological aspect of psychology is merely an attempt to find some function (in the mathematical sense) of the mutually independent mental elements, that conforms to the natural-science concept of causation. The neural activity in the sensorimotor arch is regarded as such a function. This functional relationship between the mental and the neural elements is expressed by the statement: "Every psychosis has its neurosis." If the dualistic conception of mind and body is accepted there is much experimental evidence in verification of this hypothesis. However, it is not clearly enough recognized that when the concept of a psychosis, regarded as distinct from a neurosis, is introduced, causation in the biological sense vanishes. While few critical thinkers have ever maintained that the neurosis *produced* the psychosis or that the psychosis *produced* the neurosis, yet this is just the interpretation that is given by popular psychology and implicitly at least the conception is found in the writings of many professional psychologists.

If, on the other hand, the relationship between the mental and the physical is regarded as correlational only, the concept of causality must again be relinquished. Perhaps the clearest statement of the relation between the mental and the physical that indicates the standpoint of the physiological psychologists is that expressed by Warren,² who regards the mind as one aspect and neural function as another aspect of the same series.

² Warren, H. C., "The Mental and the Physical," *Psychol. Rev.*, 1914, XXI., 79-100.

Of the two forms of relationship that are investigated by physiological psychology neither one represents a causal relationship. The links of the mental series are not causally related; the mental-neural relation is correlational, not causal.

Behaviorism is a Causal Series.—To avoid the difficulties introduced by the mental-physical concept, the behaviorist avails himself of the generally accepted fact that whatever may be the properties of the mental series these properties can only be manifested or expressed by neural activity of some sort. For the behaviorist all activity is sensorimotor activity, whether this is of the simplest reflex type or the most complex actions that express man's intellect or character. Consequently, for the behaviorist the question as to the relation between mental and neural processes becomes merely the question as to the relation between two different forms of neural activity. These interrelations however form a causal series in that any number of transition stages may be observed and the properties of those neural processes from which the psychologist infers mental states differ only in degree from those sensorimotor conditions that make up habitual activity. Thus to have an image of an orange means merely that in addition to the sensorimotor activity appropriate to the occasion (eating breakfast for instance) there is also activity in those neural structures that functioned at a previous time when the subject reacted, to say the sight of an orange, by actually eating it. The same principles of sensorimotor function that explain the activity of eating, also explain the activity of imaging.

The postulation of a special mental process as distinct from the physical, the behaviorist regards largely as the introduction of a "thing in itself" concept. If neural activity alone can become available for science, why insist that there is "something else" which can never be directly observed or investigated? This of course does not mean that the behaviorist denies that a subject may introspect. He merely maintains that introspection is one of the many forms of sensorimotor activity by which the subject reacts to his environment.

For the behaviorist then there is only a single series, the elements of the nervous mechanism and the links between successive stages form a causal relationship.

DIFFERENCES IN METHOD

In the natural sciences it is of very little consequence whether the investigator adopts a monistic or dualistic interpretation of the mind-body problem. In the study of mental and social phenomena, however, the method of investigation and the results that are secured

depend largely upon whether the investigator supports a monistic or dualistic hypothesis. Such a problem for instance as "The Analysis of the Intellect" may not mean at all the same thing for the dualist that it does for the monist.

The Method of Physiological Psychology.—Since the physiological psychologist is primarily interested in the structure of consciousness, that phase of a problem will be emphasized that can be investigated by the method of introspection. To analyze intellect, for instance, the psychologist will ask a subject to reveal through introspection what mental states are present while he is performing some intellectual process, such as solving arithmetical problems, playing chess, *etc.* The stimulus conditions under which these introspections are made are carefully controlled and the result of the experiment is a classification of the introspective reports in such a way as to reveal certain patterns of consciousness. Such an investigation can be conducted with a degree of scientific rigor and ingenuity that may even exceed that shown in the investigations of many natural science problems, and the result secured may be regarded as just as complete a record of mental structure or mental function as for instance a systematic description of the flora of a country. To extend the conclusions derived from the individual introspective reports the experimenter repeats the experiment as often as may seem necessary. The explanatory phase includes an investigation of the neural structures and processes whose functioning is correlated with the introspective reports. The validity and generality of the conclusions that are reached depend on the skill and insight of the investigator as in any experiment in the natural sciences. The end result of an experiment in physiological psychology is a report of what patterns of consciousness may be expected to occur under given conditions.

The Method of Behaviorism.—The behaviorist has no special method in the sense that introspection may be regarded as a special method in structural psychology. In the problem "The Analysis of the Intellect" the approach is from an entirely different angle. Intellect is regarded as a form of sensorimotor activity rather than a form of consciousness and the first step in the analysis is to determine what type of activity is to be characterized as intellectual. The next step is to develop some technique by which the presence or absence of this type of activity can be detected, and finally its distribution in the whole or a selected part of the population is determined. This represents the social aspect of the problem. The behaviorist regards intellect or reason, judgment, *etc.*, as a form of behavior, not as a pattern of consciousness. From the individual

side the problem becomes that of tracing the development of those actions that have been defined as intelligent, from the earliest reflex activity of the infant to the final reactions of the adult. To assume that these reactions are accompanied by consciousness is no more helpful in an understanding of behavior than it is to assume that if we knew whether the atoms in a chemical reaction actually experience affinity, valence, warmth, cold, *etc.*, we could explain chemical reactions.

The behaviorist raises the question as to whether a subject who is introspecting is actually describing mental states. Instead of maintaining that introspection reveals the character of some mental process, it is simpler to say that it reveals only the fact that the experimental stimulus, in addition to producing the experimental response (pressing a key for instance) also produces an oral response (the introspective report). All that is actually observed is the fact that the energy of the response is not a simple function of the energy and character of the stimulus. The behaviorist regards introspection as the behavior of a very special and limited class of individuals. Human laws, institutions, social customs are developed by non-introspecting individuals, and it is the behavior of this type of individual that engages the primary interest of the behaviorist. While he may of course investigate the introspective reaction, he regards it as merely one way in which a psychologist may react to a special situation. The method of the behaviorist thus reduces itself to a statistical, genetic and mechanical analysis of those movements that form the basis of human interaction.

DIFFERENCES IN SUBJECT-MATTER

The subject-matter of both physiological psychology and behaviorism in the final analysis, is human action and conduct. It is this fact perhaps that is largely responsible for identifying behaviorism with the neural aspect of traditional psychology. However, when the differences in methodology are taken into consideration the similarity in subject-matter is of no greater significance than the fact that the whole universe can be regarded as the subject-matter of mechanics or physics.

Subject-Matter of Physiological Psychology.—While selecting the form of behavior that is to be investigated, the physiological psychologist works toward establishing what mental states or processes are correlated with new or unanalyzed forms of action. The sensations, images, feelings, and emotions that accompany the manifold activities making up the life of the individual are regarded as presenting a field of investigation comparable in dignity and in the

demands upon ingenuity with that required in natural-science investigations. When in addition an attempt is made to determine what neural conditions accompany mental processes, the physiological psychologist maintains that he meets the descriptive and explanatory requirements that are regarded as constituting a science in the modern conception of the term. Mind and consciousness as revealed by introspection and as correlated with neural function represent thus the subject-matter of physiological psychology.

Subject-Matter of Behaviorism.—The development of behaviorism to some extent represents a reaction against the apparently meager achievement of physiological psychology. While certain neurological experiments may be interpreted as establishing the fact that certain mental states seem to be associated with either this or that part of the nervous system, yet as a matter of fact not even the simplest mental state or function can as yet be referred to a precise neural correlate. Singularly enough this fact is usually urged to show that behaviorism is impracticable and one-sided. While the behaviorist is of course interested in neural function, and even to a greater extent perhaps than the physiological psychologist, yet he is not merely a neurologist. His subject-matter is human behavior; those actions that are grouped under the general class names of intellect and character. In the study of these reactions a knowledge of the internal structure of the nervous mechanism is no more necessary than a knowledge of the internal structure of a molecule is necessary for a chemical analysis.

It is not clearly enough recognized that most of the experiments that are included under applied psychology, educational psychology, mental and social measurements, and even the classic memory experiment of Ebbinghaus are in reality investigations of human behavior. In these investigations no attempt is made to determine what mental or neural conditions are involved. An intelligence test, an educational test, a class examination, are merely different ways of measuring human action. Their social or scientific value in no way depends upon what assumption is made as to the presence or absence of mental or neural factors. The behaviorist's subject-matter includes a study of the stimuli and situations which act upon man, and a study of the reactions which result from the operation of these stimuli upon a nervous mechanism having certain acquired and inherited properties. What is acquired and what is inherited is not revealed by an anatomical or physiological analysis of neural function. Only the investigation of human action and conduct in its genetic developments can reveal this. The behaviorists maintain that aside from difference in anatomical structure the only differ-

ences between individuals is in the movements that they make and that these movements are to be studied in precisely the same way as any other movements, animate or inanimate. Human behavior is merely an expression of the fact that the chemical and physical conditions inside and outside the body are not in equilibrium.

The investigation of the internal neural conditions form part of the behaviorist's programme, of course, but the inability to trace the ramification of any given nervous excitation through the nervous system is no more a restriction on the study of effective stimuli and reactions in the educational, industrial or social phases of life, than is the physicist's inability to determine just what is going on in the electrolyte of a battery while a current is passing, a limitation that makes research in electricity impossible. Human behavior as a function of the environment and the nervous mechanism, represents thus the subject-matter of the behaviorist.

SUMMARY

When compared with physiological psychology, behaviorism presents differences in fundamental assumptions, methodology, and subject-matter which do not justify the implication that behaviorism is merely an emphasis upon the neural side of physiological psychology.

The fundamental assumptions of physiological psychology are based upon a dualistic system, made up of mind on the one hand and neural function on the other, both of which are *correlated* with each other, but not causally related. The fundamental assumptions underlying behaviorism are monistic. The element is the reaction regarded as sensorimotor function of which the various stages are causally related.

The method of physiological psychology is that of introspection, supplemented by an analysis of the neural factors correlated with given mental patterns. The method of behaviorism is that of a statistical, genetic, and mechanical analysis of those movements that form the basis of human interaction.

The subject-matter of physiological psychology is mind or consciousness as revealed by introspection and as correlated with neural function. The subject-matter of behaviorism is human action and conduct regarded solely as a mechanical function of the environment and the reaction system.

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